CLAIMS

What I claim as my invention is

1. A process for conversion of petroleum residua to methane comprising the steps of

    a. preheating the petroleum residue feedstock to a temperature between 300 °F and 800 °F,

    b. injecting said preheated feedstock into a reaction vessel maintained at a temperature between 1100 °F and 1400 °F, and at a pressure between 300 psig and 1000 psig, said reaction vessel containing fluidized solid particles comprising

        more than 50% by mass of petroleum coke,

        more than 30% and less than 50% by mass of alkali metal, said alkali metal being potassium, rubidium, cesium or any mixture thereof, and

        less than 10% by mass of other inorganic constituents,

    said particles being fluidized by an upwardly flowing gaseous mixture comprising at the bottom of the reactor

        more than 50% steam,

        more than 20% and less than 40% hydrogen,

        more than 3% and less than 20% carbon monoxide,

    said gaseous mixture being preheated to a temperature in excess of 1300 °F, wherein the mass flow rate of said steam is maintained at between 1.8 and 2.0 times the mass flow rate of said injected preheated feedstock, and wherein the hourly mass flow of said injected preheated feedstock is maintained at between 0.3 and 0.6 times the mass of said alkali metal,

    c. withdrawing from said reactor a gaseous product mixture comprising unreacted steam, methane, carbon dioxide, hydrogen, carbon monoxide, hydrogen sulfide, and ammonia,

    d. recovering methane from said gaseous product mixture, and

    e. recovering and recycling hydrogen and carbon monoxide to said fluidizing gaseous mixture.

2. The process of Claim 1, wherein the composition of said fluidized particles is maintained within the specified range by periodically withdrawing solids and adding alkali metal compound to said reactor.

3. The process of Claim 2 wherein the alkali metal compound is the carbonate or hydroxide of potassium, rubidium, or cesium.

4. The process of Claim 3 wherein said alkali metal compound is dispersed as a fine powder admixed with said petroleum residue feedstock at a concentration of less than 1% by mass, maintained in suspension by agitation, and injected into said reactor with said preheated injected feedstock.

5. The process of Claim 1 wherein said reactor consists of two or more stages with respect to said upwardly flowing gaseous mixture, and wherein said fluidized particles are circulated between stages.

6. The process of claim 5 wherein said fluidized particles are circulated from upper to lower stages by means of one or more standpipes, and are circulated from lower to upper stages by means of one or more aerated risers.

7. The process of claim 6 wherein said preheated feedstock is injected into at least one aerated riser.

8. The process of claim 7 wherein the mass flow rate of solids in the aerated riser is between 5 and 20 times the mass flow rate of said injected feedstock.

9. The process of claim 7 wherein said gaseous product mixture is withdrawn through at least one pair of cyclone separators in series, said series consisting of a primary cyclone separator discharging into the inlet of a secondary cyclone separator, each cyclone separator being equipped at the bottom apex of its conical section with a pipe dipleg to discharge the collected fine particles separated from

said gaseous product mixture, and wherein the dipleg of the secondary cyclone separator discharges into a collection zone coupled to the inlet of a jet ejector, and wherein said jet ejector discharges the collected fine particles into the riser below the level of feedstock injection.

10. The process of claim 9 wherein said jet ejector is operated with sufficient motive fluid to induce a downflow of gas and entrained solids in said dipleg of said secondary cyclone separator, said gas and solids to proceed downwardly with a superficial velocity of more than 0.1 meter per second and less than 1 meter per second.